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ABSTRACT

In Flemish education, there is an ongoing debate regarding the implementation of the concept of student centered education within educational settings. In order to investigate student teachers' beliefs about the learning environment within the learning to teach process, this case study, conducted within two departments of preservice and inservice teacher education, examined student teachers' beliefs and reflections about the stimulus of more self-regulated and cooperative learning, noting how those reflections should be translated into educational practice. Interview data indicated that student teachers tended to be strongly occupation oriented and favored the use of knowledge during the learning process itself. They generally agreed with the statement that learning was about recording knowledge and relied on learning strategies such as stepwise, concrete processing, and external regulations. They had little reliance on self-regulation strategies. Beliefs about learning differed by type of teacher training. Student teachers tended to favor authentic learning on a continuum from traditional to self-discovery learning. Teacher training institutions that promoted more authentic and self-discovery learning influenced student teachers' perceptions of education toward using and constructing knowledge. (Contains 28 references and 8 tables.) (SM)

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Beliefs about learning environments: How do student teachers think, reflect and act concerning self regulated and cooperative learning in Flanders (Belgium)?

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Paper presented on AERA congress in Chicago, 23rd April 2003.

Abstract

In Flanders there is a growing innovation sensibility concerning self regulated learning. In order to be able to take into account the actual beliefs of student teachers about learning environments within the learning to teach process, an explorative case study research is conducted within two institutions of pre-service and in-service teacher education. The aims are to examine on the one hand the beliefs and reflections of student teachers about the stimulus of more self regulated and cooperative learning and on the other hand to explore how those reflections should be translated into educational practice. Further, research takes place in which ways student teachers consider reflective learning as a surplus in the implementation process of powerful learning environments.

Introduction

In Flemish education, there is an on going debate to implement the concept of student centred education within educational settings (Dochy 2000, Van Petegem, 2002). Most of the inspiration for these pleas originates from different scientific, educational and social disciplines. The insights deriving from socio-constructivist learning theories, the knowledge of procedures to enhance powerful learning environments and the consciousness of the variety of skills that learners need in order to cope with a postmodern knowledge and information society, stimulate in a growing way, a consciousness for the necessity of educational changes. The knowledge of arguments from different disciplines creates an interdisciplinary felt necessity for innovations directed to implement the principles of more student centred education and a willingness for an overall educational change. The necessity of the so-called paradigm shift that has been stated by e.g. Howell (1998) is also felt in the use of the socio-constructivist 'jargon' that nowadays is more commonly used within a number of mission statements of educational innovation of institutions. It is also known that this popularity of use of educational jargon is however no guarantee for effective educational innovation. A hypothesis in this area could be that the willingness of innovation is almost never to be compared with an equal innovative practice. In comparison with the Netherlands, (e.g. Bolhuis, 2000) we can also claim in Flanders that the known gap exists between the retoric (*talking the* walk) and practice (*walking the talk*) of educational innovation concerning self regulated learning (e.g.Van Looy, 2002).

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The indication of frictions between vision (mission statement) and realization of educational innovations stimulates in some institutions of Higher Education the necessity of research-based reflections concerning adequate innovation strategies. We can state that by means of the willingness of some institutions that agreed on practical research of possibilities and boundaries of educational innovation strategies. The research group EduBROn conducted research in several more annual projects concerning the stimulus of more research based reflections towards education innovation strategies directed to the implementation of more student centred education. More specifically the execution of educational design research is promoted (De Corte, 2000). This is reflected in our use of case specific research tasks (e.g. explorative and diagnostic research) and coaching tasks (e.g. action research). In this way a vision upon educational research is promoted in which the attention is focussed to bridge in as much as possible the so-called gap between 'research about education' and 'research for education'(Carr & Kemmis, 1986, Eliot 1991).

Research considering the possibilities and boundaries of specific educational innovation strategies are complex (Fullan, 1993, Van den Berg & Vandenberghe, 1999). Different actors and factors play an intertwining role within the process of realizing certain innovation visions. Beliefs about learning, instruction and the realization of learning environments from actors (e.g. students, teachers, and policy makers) have to be taken into account. It is known that these underlying beliefs have a not to be mistaken influence on the development and realization of educational innovation (Roelofs, 2001). Besides the influence of actors also factors like e.g. social, cultural and material aspects play an important role in the realization of 'education' (Bolhuis, 2000, 213). We can basically speak about subjective (actors) and objective (factors) powers that influence the acting of actors that are part of educational innovation strategies.

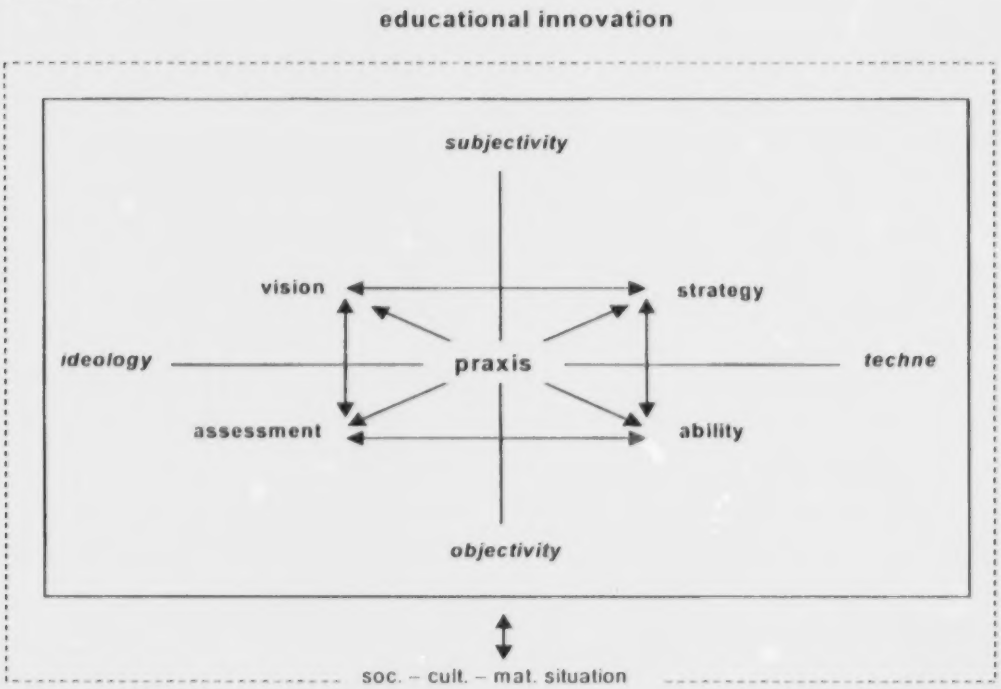
Postmodern oriented visions upon education and knowledge undermine the black-and-white distinction between 'object' and 'subject' because knowledge about 'objectivity' is in itself a subjective construction and vice versa (e.g. Mottart, 2002). In order to break through this dichotomy one speaks in sociological terms about 'praxis' or the mixture of perceptions and actions that in reality are a specific linking between what is from a subjective perspective viewed as 'desirable' and what is from an objective perspective viewed as 'reachable' (e.g. Bourdieu, 1980). From this point of view, research about praxis can occur by means of attention to both objective and subjective components that are influencing the acting of actors.

From the perspective of didactics also Riedel (1977) used the term 'praxis' to indicate a distinction between three knowledge fields (ideological, technological and empirical knowledge) that are also related to both subjective (desired actions) as objective (factual action) aspects of 'reality'. In a recent study Ponte (2002) considers those three knowledge fields of Riedel as fields in which teachers have to develop insights (professional knowledge) in order to be more oriented to own goals and carry out more self responsible actions within practice.

In our research projects in which the stimulus of research based reflections considering educational innovation strategies is centralized we stress upon the importance of gaining more insights into the praxis of several actors (students, teacher and policy makers) by means of an explorative research into the three knowledge fields of Riedel (1977). In combination with the previously designed distinction between subjective and objective forces we can draw two continua that in their way make a distinction between four domains in which we want to stimulate research based insight : in (a) vision: insight of the desired actions; (b) strategy:

insight in the desired forms; (c) ability: insight in the factual forms; (d) assessment: insight in factual actions. In the following figure one can see a summary of our general research frame.

Figure 1
Research frame



Two case studies

The following paper describes a research carried out within the previously sketched research frame (figure1). It is an approach to describe more precisely the subjective beliefs within the praxis of students that are participants of specific innovation strategies. In this paper a report is done about research that was conducted within two departments of teacher education of institutions of Higher Education. There was a collaboration with both a non-university department organising three types op teacher education (pre-primary, primary and lower secondary education) and a university department organising teacher education (upper secondary education). In both cases there has been a serious effort for stimulus of educational innovation projects for several years. Starting from their concerns to gain more insight into effective innovation strategies, two case studies (institution based) were set up in which also research took place considering the beliefs of students about learning (1.1.), the preference of learning environments (1.2.) and possible interactions between learning and preferences of didactics and learning environments (1.3.). The main aim of the research was concerned with gaining more research based insight which can be used for possible assessment reflections concerning present or future education innovation strategies. In the following parts the frame of reference, methodology, some case specific and cross case results, conclusions and implications of this research will be briefly discussed.

1. Frame of reference

1.1. Beliefs about learning

About the importance of mapping the beliefs of learning and more specifically learning styles and the relation with learning environments to stimulate more process oriented instruction there has been many research carried out before (e.g.Vermunt, 1992). Also in Flanders the mapping of learning styles seems to be a surplus for research about the conditions of the development of learning attitudes that are adequate within education directed to more self regulated learning and autonomous learning (Van Petegem, 1998). In this research we used the 'Inventory for Learning Styles' (ILS) as developed by Vermunt (Star-centre, 1997). This instrument investigates learning styles of students and consists of 16 parts (scales). Three scales deal with cognitive learning activities, three with metacognitive learning activities, five perceptions on education and five orientations towards learning. A learning style includes 4 parts: (1) cognitive learning activities, e.g. relating theory to primary knowledge, structuring, critical learning, stepwise learning, making concrete or applying knowledge; (2) meta-cognitive learning activities, e.g. self regulation, external regulation; (3) orientation towards learning, e.g. personally interested learning, certificate or test oriented learning; (4) perceptions on education, e.g. constructing knowledge, absorbing knowledge, using knowledge, stimulating education and working together. By means of individual scores of students on the 16 scales one can distinguish 4 prototypical learning styles (table 1). A learning style is defined as the combination of the cognitive learning-activities, the regulation of these learning-activities (meta-cognition), the perceptions on education and the orientation towards learning. Vermunt distinguishes four learning styles. The unregulated learning style, the reproduction-oriented learning style, the application-oriented learning style and the meaning-oriented learning style (Vermunt, 1992, 73-99). The differences between the learning styles have to do with which cognitive learning activities, metacognitive learning activities, orientation towards learning and perceptions on education.

Table 1
The combinations of learning-style components (STAR-centra, 1997, 8)

LEARNING STYLE COMPONENTS	MEANING ORIENTED	REPRODUCTION ORIENTED	APPLICATION ORIENTED	UNREGULATED
COGNITIVE LEARNING ACTIVITIES	Relating and critical processing	Memorizing and analyzing	Making concrete and applying	No specific cognitive learning activities
METACOGNITIVE LEARNING ACTIVITIES	Self regulated	Externally regulated	Self and externally regulated	No regulation
ORIENTATION TOWARDS LEARNING	Personally interested	Certificate and test-oriented	Occupation oriented	Ambivalent
PERCEPTIONS ON EDUCATION	Constructing knowledge	Absorbing knowledge	Using knowledge	Stimulating education and working together

Meaning oriented. These students tend to specifically use more relating and structuring learning activities and the learning activity of critical processing. These students are very able to capture the large content of the subject matter because they can make very good distinctions between main and side aspects of the subject matter. Therefore they make use of schemes of subject matter. They provide in the execution of metacognitive learning activities (e.g. self regulation). They posses an orientation towards learning that convenes with personal interest in learning in which learning is seen as constructing knowledge. These students are

fast and easy learners. The quality of the learned subject matter is high; student can apply the subject matter very easily. They gain on average good points and are capable of self regulated and autonomous working and learning.

Application oriented. These students use cognitive learning strategies directed to make things concrete and applicable and use that as learning activities. They are capable to imagine by themselves examples to subject matter and direct their attention to knowledge that is applicable. They provide once more once less in the execution of metacognitive learning activities. Their perception on education is that knowledge is needed to be used and be applicable in practice. Their orientation towards learning insists that they want to qualify themselves for a profession. The quality of the learned knowledge differs, depending on the application of the subject matter. If the study is derived from their interest then no problems occur. If this is not the case then they undergo the same problems as students with a *reproduction oriented learning style*. The students are in some way moderately capable of self regulated and autonomous learning and working.

Reproduction oriented. During learning process these students use learning activities as memorizing, (e.g. repetition) and analyzing (e.g. stepwise learning). They are mainly focussed on details, major lines are not to be taken into account. Learning consists of learning by heart definitions and facts. The regulation of learning activities is external. Their perception on education is based upon a view of learning as absorbing knowledge. Their orientation towards learning is focussed upon getting certificates, diplomas and gaining good scores. Their learning process needs much time because of studying large amounts of subject matter in which memorizing and repetition by heart is little efficient. The danger to get lost during the learning process in mere independent facts is real. The quality of the learned subject matter is low. Mostly these students are incapable of self regulated and autonomous learning.

Unregulated learning. During the learning process these students apply very little cognitive learning activities. The metacognitive learning activities can not be directed by the students themselves, they are most of the time adrift. Learning is for them collaboration with fellow students and education is perceived as a means to stimulate them. Their perception on education is ambivalent; they don't know with which goals they have to follow education. These students have usually learning problems and are hardly incapable of self regulated autonomous learning.

1.2. Beliefs about learning environments

The beliefs about education and learning environments can be distinguished in distinctions between subject matter oriented or student oriented perceptions (Denessen, 2000). The contemporary evolution concerning learning environments is characterized by the transformation of traditional learning environments in which education is mostly regarded as a process of content delivery (knowledge-based) towards innovative student centred learning in which the process of acquisition of knowledge itself is centralized (process-based). Relating to this frame, Roelofs et al. (2000a) developed a transition model which captures some of the present educational innovations and is based upon the construction of types of learning environments. In the positioning of types of learning environments one can take into account six so called oppositions. (1) construction versus absorbing knowledge; (2) learning by means of complex versus sequences of tasks, (3) personally versus every-day construction of meaning; (4) learning in professional and scientific contexts; (5) cooperative learning versus individual learning and (6) developing a learning climate versus a performance

oriented learning climate. When placed upon a continuum, polarised on the one hand by the classic knowledge delivery model and the transformation model of 'student centred' education on the other hand, several types of learning environments can be distinguished. Roelofs (2000b) developed a questionnaire by which a number of scale scores can be counted that indicate preferences. Relying on the six de cribed continua one can derive where a preference for a type learning can be situated within the transition model. In the research in which Roelofs (2001) described preferences of students, teachers and parents as well, he examined the variety of learning environments on the basis of four dimensions: (1) traditional oriented education; (2) authentic learning; (3) self-discovery learning and (4) importance of self regulation in education. The advantage of this interpretation lies in the fact that extreme perceptions of learning environments are not exactly stated.

Traditional education is characterised by a more on transmission directed learning environment in which also process oriented variants can exist. In general it considers a learning environment in which the role of the teacher is to regulate, evaluate and to keep up the time management of learning process. There is a particular stress upon stepwise instruction, awarding effort with scores and a prevailing delivery of knowledge/facts. *Authentic learning* implies an in between position on the distinguished continuum and is characterised by a constructivist oriented learning environment in which long termed tasks, practice related 'authentic' tasks, the execution of mini-researches, and working with other kinds of media and formative evaluation is focussed. In this learning environments, self regulated and autonomous working is centralized. However students are not capable to determine their own learning goals or have self autonomy in regulation, this is still done by the teacher. *Self-discovery learning* is characterised by a stress upon the importance of self regulation in which the students in a higher degree take over learning functions (Shuell, 1996) from their teacher. The fourth dimension *importance of self regulation in education* covers the perceptions about a generally felt importance of self regulation in order to stimulate more autonomous or independent learning in education.

1.3. The relationship between beliefs about learning and learning environments

Research about the ways in which students differ in beliefs about learning and learning environments can also be related to one and other. We can state by Vermunt (1992) that students with meaning oriented learning styles need learning environments that enables to those learners to fully use their sense of self regulation (e.g. more self determination about the ways in which learning has to be undertaken). The study of interactions between learning and instruction strategies is considered to be interesting for diagnostic purposes to improve present educational practice (Vermunt, 1998). Roelofs (2001) underlined that perceptions about learning and instruction of teachers can be in a certain way predictors of preferences of certain types of learning environments. The question remains whether we also in this case study can find a predictive relationship between the described learning styles and the preferences of learning environments. Another question deals with the possibility of changing the perceptions of learning and preferences of learning environments. Does the relationship between perceptions of learning and the preferences of learning environment implies a temporal or permanent relationship? The set up of our research is characterised by means of a pre-test post test design in which we want to set up a basis for further longitudinal research on this topic. [1]

[1] However these results can not be discussed within the context of this paper since at the time of writing only quantitative data of the pre test phase are collected.

Research by means of the two questionnaires of Vermunt and Roelofs serves a certain double goal related to these case studies. Firstly the results will learn us something about the ways in which student teachers differ in perceptions considering learning and their subjective interpretations of adequate learning environments. Secondly, the preferences that they pretend to have can be related to their learning styles. Obviously, this research has an immediate relevancy in exploring possibilities and boundaries of innovation strategies within the involved institutions. In this paper we selectively report results on the following questions:

(1) Can a distinction between learning styles of respondents be made using the ILS-scales developed by Vermunt?
(2) Which preferences do students pretend to have concerning learning environments?
(3) Which are the differential effects concerning research question 1-2 on the basis of type of teacher education and gender?
(4) What is the relationship between the ILS-scales and the preferences of learning environments?

2. Methodology

2.1. Research group

In this research 1618 student teachers of both institutions were involved. There are 1463 respondents of a non-university department organising three levels of three-year teacher education (pre-primary, primary and lower secondary education). A total of 155 respondents of a university department organising one-year teacher education (upper secondary education) were involved.

2.2. Research instruments

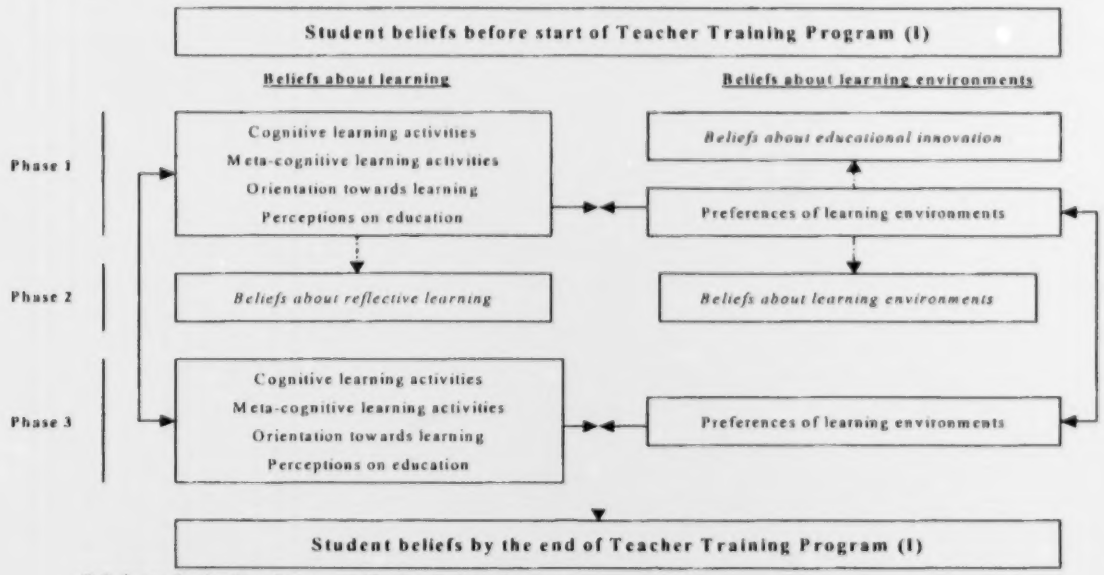
In this research phase (figure 2, phase 1) three questionnaires were applied. The first questionnaire was 'the inventory of learning styles' (ILS) as developed by Vermunt (Star-centre,1997) and was translated to the Flemish situation. Former research has shown that this inventory is a valid measure of learning styles (Van Petegem, 1998). In the questionnaire, 27 items are related to the *processing strategies*, 28 items on *regulation strategies*, 25 items on *orientation towards education*, 40 items on *perceptions on education*. The items are to be filled in on a Likert scale of 1 (I do this seldom or never) till 5 (I do this (rather) always) for the first 55 items and 1 (I disagree on this) till 5 (I agree on this) for the rest of the items. The second questionnaire was 'the preferences of learning environments' of Roelofs (2000b). We used a selection of the scales that were firstly used for visualising parental preferences of learning environments. Four scales of Roelofs were proved to be reliable to represent the former indicated continuum of types of learning environments. In the questionnaire, 17 items are related to the *preference for authentic learning*, 10 items on *preference for self- discovery learning*, 10 items on *preference for traditional education* and 8 items dealing with the *importance of self regulation in education*. The items are to be filled in on a Likert scale of 1 (this does not apply to me) till 4 (this does apply to me) for the first 37 items and 1 (very unimportant) till 4 (very important) for the other items. Besides other student personal and context variables were asked such as gender and type of education. All questionnaires were introduced by information about the goals of the research.

2.3. Procedure

Each case study research (Yin, 1994) was conducted during the academy year 2002-2003 and fits into a larger research design which is set up by means of a mixed methodology-design (Tashakorri, 1998). The design contains a pre-test post test structure in which three phases can be distinguished. (figure 2). In the first phase quantitative survey research takes place by

means of the two described questionnaires: the questionnaire of Vermunt exploring beliefs of learning and the questionnaire of Roelofs exploring the preferences of learning environments of students. In this phase a pre-test takes place at the beginning of a year of Teacher Training Program (I). The opposed arrows indicate research about the relationship between beliefs about learning and learning environments. In the first phase also research takes place concerning beliefs about educational innovation by means of an open ended questionnaire. Each qualitative research is indicated in figure 2 by an arrow dotted line with text in *italics*.[2] A second phase consists of a qualitative research about beliefs about reflective learning and learning environments. This is carried out by means of open ended questionnaires, focus group interviews and analysis of student logbooks. This research is directed to gain more in depth insights into reflective learning and the perceptions of learning environments. Only one institution took part in this qualitative part of research. A third phase consists of a post test at the end of a year of Teacher Training Program (I) in which again the two quantitative questionnaires are to be filled in by the students of two institutions in order to be able to analyse changes in beliefs about learning and learning environments. In this phase also research takes place about the relationship between beliefs about learning and learning environments and research about the changes that may occur between phase 3 and phase 1 (opposed arrows). In this paper we are unable to discuss the results of qualitative data of phase 1 and other research phases (2 and 3) since at the time of writing only quantitative data of the pre test phase are collected. The participation of individual students occurred on free base and without any compensation or reward.

Figure 2
Research phasing



(I) Refers to the duration of one year of Teacher Training Program

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[2] By this time we can not report results of the qualitative part of phase 1 and 2.

2.4. Data analysis

The beliefs about learning and preferences of learning environments will be described by means of descriptive statistics (research question 1 and 2). The student is considered to be the unit of analysis. By means of multivariate analysis of variance and cluster analysis we evaluate the possible differences between respondents according to learning style and preference of learning environment (research question 3). By means of stepwise multiple regression analysis we evaluate in which ways the preferences of learning environments by student teachers can be predicted by the beliefs about learning. (research question 4). The qualitative analysis of beliefs about education change will in future be analyzed using standard qualitative data analysis techniques (Miles & Huberman, 1994)

3. Results

3.1. Beliefs about learning

3.1.1. Reliability, scale scores and differences between subgroups

Scale scores of the 16 learning style scales were calculated depending on the mean item score of individuals. Table 2 summarizes descriptive statistics of different types of teacher education, namely pre-primary education, primary education, lower secondary education and upper secondary education. For each scale the mean scale score and the results of a one-way ANOVA are also reported. Information on the internal consistency of the scales is included as well.

An investigation of the mean scale scores learns that student teachers in general indicate to be occupation oriented and that they favour the use of knowledge during the learning process itself. Furthermore the recording as well as the construction of knowledge are promoted. This reveals that student teachers point out that they are eager to construct and use knowledge in an occupation oriented context while in the meantime they rather agree with the statement that learning is about absorbing knowledge. This 'traditional' aspect of their view on learning also turns out apparent from the findings that student teachers indicate that they rather rely than not rely on learning strategies such as stepwise, concrete processing and external regulations. Furthermore, they seem to rely little on self regulation strategies.

There are however some differences between the different types of teacher training[1] worth mentioning. Students preparing for pre-primary education significantly rely less on deep processing strategies than their colleagues preparing for other levels of education. They tend to use slightly more frequent stepwise and concrete processing strategies, they are somewhat more external or not regulated than others and they most strongly stress the importance of using knowledge. In comparison with the other groups they are strongly certificate and occupation oriented. Finally, they are only to a minor extent personally interested.

Students preparing for primary education and lower secondary education generally do not have mutual meaningful significantly different scores (except for occupation and test orientedness) and hold a position between student teachers preparing for pre-primary and upper secondary education. Their mean scale scores always fall between the extremes of these two groups.

[1] Although statistically significant some of the absolute differences found between mean scale scores are rather small. In the interpretation we focus on the largest and interpretable differences.

Student teachers preparing for upper secondary education strongly rely on deep processing while learning and less on stepwise and concrete processing. They are less external or not regulated but self-regulation is equally low as in the other groups. Although less occupation oriented than the other groups, this orientation is still more important than their personal interest or orientation towards certificates or tests. Remarkable is the finding that student teachers preparing for upper secondary education are - on the one hand- far more personally interested than the other groups whereas -on the other hand- they agree less with statements relating to the importance of using knowledge while learning.

Table 2
Reliability, descriptive statistics and differences between different groups of student teachers (N=1680).

	Scale	pre-primary education	primary education	lower secondary education	upper secondary education	ANOVA	POST HOC
		A	B	C	D		
1	Deep Processing (11 items, α = .85)	2.97	3.08	3.16	3.59	F=37.01 p < 0.001	AC, AD, BD, CD
2	Stepwise Processing (11 items, α = .73)	3.29	3.21	3.12	3.12	F=7 p < 0.001	AC, AD
3	Concrete processing (5 items, α = .65)	3.32	3.16	3.15	3.09	F=6.38 p < 0.001	AB, AC, AD
4	Self regulation (11 items, α = .77)	2.62	2.69	2.64	2.8	F=4.31 p < 0.01	AD, CD
5	External regulation (11 items, α = .65)	3.33	3.22	3.13	3.02	F=19.72 p < 0.001	AB, AC, AD, BC, BD, CD
6	No regulation (6 items, α = .71)	2.65	2.48	2.52	2.04	F=32.45 p < 0.001	AB, AC, AD, BD, CD
7	Certificate oriented (5 items, α = .65)	3.25	3	3.2	2.81	F=22.24 p < 0.001	AB, AD, BC, BD, CD
8	Occupation oriented (5 items, α = .68)	4.34	4.4	4.1	3.81	F=66.14 p < 0.001	AC, AD, BC, BD, CD
9	Test oriented (5 items, α = .79)	2.99	2.78	3.09	2.72	F=14 p < 0.001	AB, AD, BC, CD
10	Personally interested (5 items, α = .52)	2.44	2.5	2.88	3.26	F=128.41 p < 0.001	AC, AD, BC, BD, CD
11	Ambivalent orientation (5 items, α = .74)	2.07	2.02	2.09	2.01	NS	NS
12	Recording knowledge (9 items, α = .76)	3.81	3.68	3.53	3.23	F=47.84 p < 0.001	AB, AC, AD, BC, BD, CD
13	Constructing knowledge (9 items, α = .72)	3.48	3.5	3.45	3.66	F=9.07 p < 0.001	AD, BD, CD
14	Usage of knowledge (6 items, α = .76)	4.2	4.16	3.93	3.74	F=53.02 p < 0.001	AC, AD, BC, BD, CD
15	Stimulating education (8 items, α = .88)	3.11	3.22	3.25	3.37	F=5.17 p < 0.001	AD
16	Working together (8 items, α = .86)	3.08	3	3.02	2.93	NS	NS

Interpretation of the scale scores:
- ✓ scales 1-6: 1= I do this seldom or never, 2= I do this sometimes, 3= neutral or don't know, 4= I do this often, 5= I do this (rather) always;
- ✓ scales 7-16: 1= I totally disagree on this, 2= I largely disagree on this, 3= neutral or don't know, 4= I largely agree on this, 5= I agree on this.

Post hoc test used is Tukey's HSD

3.1.2. Cluster analysis

In order to make a distinction between learning styles we performed a cluster analysis on the basis of the 16 separated ILS-scales. Students were grouped together in clusters using the

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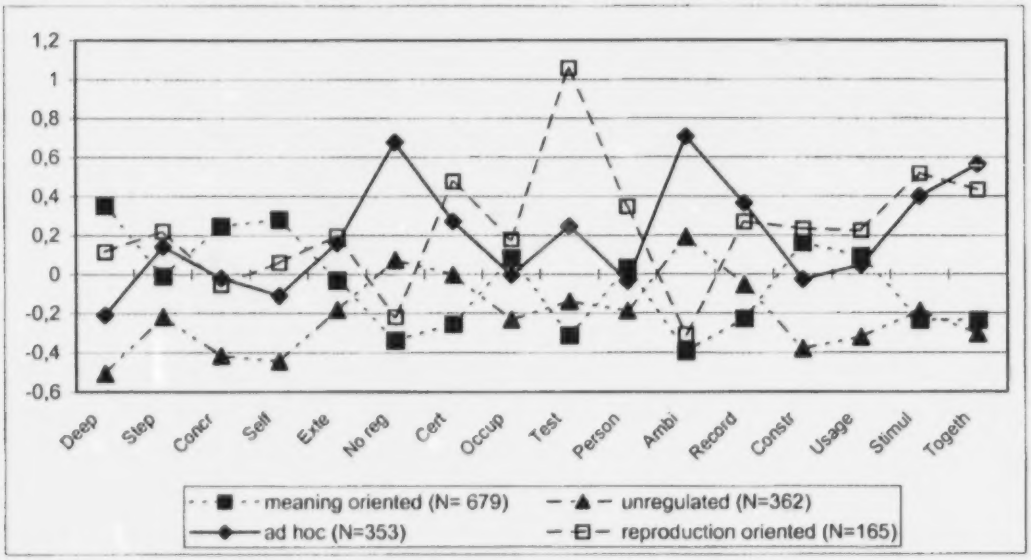
Ward method (1963). Given the presupposition of four learning styles from former learning style research (Vermunt, 1992) we theoretically assumed a distinction into four clusters (figure 3). Our intention was to confirm the distinction between the four learning styles found by Vermunt (1992), but the cluster analysis did not completely support the former findings. Therefore attention is given to an alternative 'ad hoc-learning style'. The four group clustering explained a mean variance of 17.0% of the 16 learning style scales (the lowest amount of variance was explained on the scale 'occupation oriented' (5%) and the highest amount on the scale 'ambivalent orientation'(34%)).

Figure 3
Cluster analysis (N= 1559)



Three clusters can be related to the learning style types described by Vermunt (1992): meaning oriented, unregulated, and reproduction oriented. A fourth learning style named 'ad hoc learning style' has characteristics of both the reproduction oriented and unregulated learning style. The distinguished application oriented learning style has not been found. This seems rather surprising given the assumed application and occupation oriented approach in institutions for teacher training. However, the fact that we did not find the application oriented learning style does not imply that student or not occupation oriented or attach no importance to usage of knowledge. In fact all students have high scores on these learning scales (see table 2). It implies that it is difficult to distinguish between groups of students based on their occupation and usage of knowledge.

The four clusters as found in our research group are described below.

> *Meaning oriented.* Deep processing and making things concrete are part of their cognitive learning strategies. They provide in the use of metacognitive learning activities. They posses an orientation towards learning that convenes with personal interest in learning. Their perception on education is based upon a view of learning as constructing knowledge.

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Reproduction oriented. Stepwise learning and learning by heart is preferred although some minimum deep processing activities can be noticed. The regulation of learning activities is external. The orientation of learning is mainly test oriented but also focussed upon gaining certificates and diplomas (performance based). Education is perceived as a means to stimulate learning in collaboration with others.

Ad hoc. Stepwise learning and learning by heart with rather no deep processing activities are frequent. These students are very much adrift in their learning. Learning is for them absorbing knowledge in collaboration with others. Education is perceived as a means to stimulate learning.

Unregulated. No specific cognitive activities occur. These learners are very much adrift in their learning. This is also reflected in their ambivalent perception of education; they have almost no ideas about the goals of education. As opposed to the ad hoc learning style these students have no specific ideas about how education has to be perceived.

The following two tables (table 3) inform on the distribution of the four learning styles over type of teacher education and gender.

Table 3

	Meaning oriented	Unregulated	Ad hoc oriented	reproduction oriented	*Total*
Pre-primary	40,2%	22,7%	28,0%	9,0%	100%
Primary	47,9%	22,5%	21,1%	8,6%	100%
Lower secondary	38,5%	25,7%	22,3%	13,5%	100%
Upper secondary	52,7%	21,2%	15,2%	10,9%	100%

	Meaning oriented	Unregulated	Ad hoc oriented	reproduction oriented	*Total*
Male	38,6%	29,4%	21,9%	10,1%	100%
Female	45,2%	21,1%	23,1%	10,7%	100%

The largest group of student teachers is meaning oriented. In the group of student teachers preparing for upper secondary education even 52,7% is meaning oriented. In the other types of teacher training the share of meaning oriented students is somewhat lower. It is lowest in the lower secondary group (i.e. 38.5%). The amounts of unregulated and reproduction oriented students are largely equal over the different groups. Ad hoc oriented students are mostly found in the pre-primary group (28%) and least in the upper secondary group (15,2%). Gender also seems to matter. Whereas males are equally ad hoc oriented and reproduction oriented compared to females, there are some differences for the other two learning styles. Compared to males (1) more females turn out to be meaning oriented and (2) less females appear to be unregulated.

3.2. Preferences of learning environments

3.2.1. Reliability and differences between gender and type of education

Scores on the four *preferences of learning environments* scales were calculated depending on the mean item score of individuals. Table 4 summarizes descriptive statistics of different types of teacher education, namely pre-primary education, primary education, lower

secondary education and upper secondary education. The marginal means are related to gender and information on the reliability of the scales is also presented.

Table 4

Type	Preference for authentic learning (17 items, α = .74)			Preference for self-discovery learning (10 items, α = .72)			Preference for traditional learning (10 items, α = .60)			Importance of self regulation (8 items, α = .75)		
	Gender		Tot.	Gender		Tot.	Gender		Tot.	Gender		Tot.
	Male	Fem.		Male	Fem.		Male	Fem.		Male	Fem.	
pre-primary education	3,23	3,12	3,13	3,08	2,80	2,81	2,60	2,48	2,48	2,98	2,83	2,83
primary education	3,14	3,24	3,23	2,70	2,75	2,75	2,38	2,38	2,38	2,65	2,63	2,64
lower secondary education	3,07	3,22	3,16	2,69	2,66	2,68	2,44	2,41	2,43	2,65	2,59	2,61
upper secondary education	3,06	3,10	3,08	2,47	2,49	2,48	2,49	2,44	2,46	2,34	2,45	2,42

Interpretation of the scale scores:
- ✓ scales 1-3: 1= I totally disagree on this, 2= I disagree on this, 3= I agree on this, 4= I totally agree on this;
- ✓ scale 4: 1= Very unimportant, 2= unimportant, 3= important, 4= very important.

Post hoc test used is Tukey's HSD

Due to the violation of assumptions in order to perform a sound MANOVA, a two-way variance analyses was assumed to be the adequate technique. This strategy has been preferred above a one-way variance analysis because in this manner besides the main effects of the independent variables also the significant interactions in between can be detected (Table 5). Moreover we can calculate the united attribution of the factors and their interactions with prediction of dependent variables. In figure 4 one can find a graphic summary of the results of the two-way ANOVA that was carried out.

Table 5

Significance of the main and interaction effects (NS= non significant, S= significant)

Scales	Gender	Type of education	Interaction	R^2
Preference for authentic learning	NS	S	S	,057
Preference for self-discovery learning	NS	S	NS	,060
Preference for traditional learning	NS	S	NS	,017
Importance of self regulation	NS	S	NS	,082

The impact of type of education and gender on the four scales relating to preferences of learning environments is discussed in the following.

Authentic learning. The overall mean scale scores reveal that student teachers agree most with statements relating to authentic learning. They indicate that education has to be more authentic above self-discovery and certainly traditional. There is no main effect of gender on the preference for authentic learning. Gender is however involved in an interaction effect with type of education on the preference for authentic learning. This means that the effect of type of education is not the same for male and females (as can be seen in figure 4b). Post hoc tests for the main effect of type of education indicate that student teachers preparing for primary education score significantly higher on preference for authentic learning than the other

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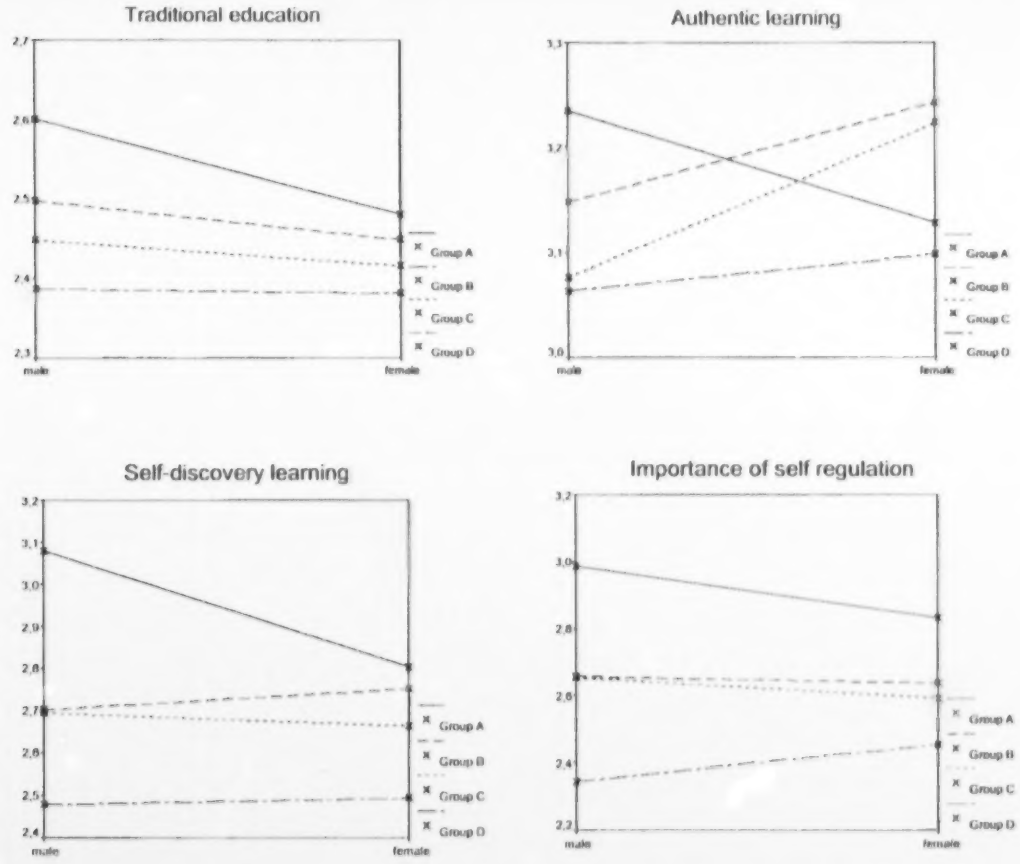
groups. The interaction effect however reveals that this is only true for females and not for males. No other statistically significant differences were found.

Figure 4



NB.: Group A: pre-primary, Group B: primary, Group C: lower secondary, Group D: upper secondary

Self-discovery learning. In all types of teacher training, students agree less with statements concerning self-discovery learning than authentic learning. Self-discovery learning is however preferred above traditional education. There is no main effect of gender on the preference for self-discovery learning, nor an interaction effect with type of education. The effect of type of education is however significant. Students preparing for upper secondary education prefer less self-discovery than the other groups. The pre-primary school group scores significantly higher than the lower secondary group but does not significantly differ from the primary education group.

Preference for traditional learning. Compared to authentic and self-discovery learning, traditional learning is preferred less by all groups of student teachers. Post hoc tests reveal significant differences between the pre-primary and the upper secondary groups on the one hand and the primary group on the other hand. Although statistically significant these differences turn out to be very small.

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Importance of self-regulation. The fact that the response categories for the 'importance of self-regulation' scale differ from the categories used with the other scales, implies that a comparison of the mean scale score with other scales would not be sound. What we do learn from the results is that all groups of students in average do not clearly state that they find self-regulation important or unimportant. The mean scale scores are all situated between 2 (= unimportant) and 3 (=important). The student group preparing for pre-primary education however finds it significantly more important than the other groups. On the other hand the upper secondary education group significantly attaches less importance to self-regulation than the other groups. In this way one can speak about a gradual delining trend to attach less importance to self-regulation by students that follow higher levels of teacher education.

3.2.2. Differences between learning styles and preferences of learning environments

The preferences of learning environments are regarded as four dependent variables, and our hypothesis is that these four together are affected by the leaning style of students. We performed a multivariate analysis of variance (MANOVA) to test this hypothesis. Instead of an univariate *F* value, we obtain a multivariate *F* value (Wilks' *lambda*). We prefer this approach because the four Roelofs scales are intercorrelated. These correlations must be taken into account when performing the significance test. The multivariate overall test indicates that there are some significant differences between the group means of the four learning styles (Wilks' lambda= 0.005[4], p<0.001).

Table 6

	Scale	Meaning oriented	Unregulated	Ad hoc oriented	reproduction oriented	UNIVARIATE TESTS	POST HOC
		A	B	C	D		
1	Preference for authentic learning	3.22	3.04	3.19	3.31	F=38.94 p < 0.001	AB, AD, BC, BD, CD
2	Preference for self-discovery learning	2.72	2.64	2.73	2.77	F=5.57 p < 0.001	BC, BD
3	Preference for traditional learning	2.33	2.44	2.50	2.47	F=20.8 p < 0.001	AB, AC, AD
4	Importance of self regulation	2.63	2.64	2.70	2.68	NS	NS

The mean scale scores indicate that students with different learning styles all primarily take a position of authentic learning on the continuum from traditional to self-discovery learning. The clustering in four groups of learning styles does not result in large differences in the preferences of learning environments. As such the clustering on the basis of learning styles is not successful in discriminating between preferences of learning environments. Although some significant differences between the learning styles are found, these differences are rather small and to some extent contradictory (e.g. the reproduction oriented learning style group turns out to have the highest preference for authentic and self-discovery learning). Because of these interpretation problems we will abandon the approach of learning styles in the remaining of this paper. In order to predict student teachers' preferences for learning environments we will again rely on the 16 different learning styles scales (see 2.2.).

[4] Lambda ranges between 0 and 1, with values close to 0 indicating the group means are different and values close to 1 indicating the group means are not different (equal to 1 indicates all means are the same).

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3.2.3. Evolution of preferences of learning environments during teacher training

Three of the four types of teacher education involved in this study are spread over three consecutive years. These are the courses preparing for pre-primary, primary and lower secondary education. Based on the cross-sectional results of the three separate year groups we are able to gain insight in whether the preferences of learning environments evolve during the three years of training. The ANOVA-results presented in table 7 reveal some statistically significant differences between year-groups. The preference for authentic learning is lower for the first year-group than for the second and third year-groups. The preference for traditional learning on the other hand significantly decreases each year.

Although statistically significant these differences are in fact very small. This raises questions towards the possibilities and/or capabilities of teacher training institutions to influence and direct the preferences of learning environments of future teachers.

Table 7

Scale		First year A	Second year B	Third year C	UNIVARIATE TESTS	POST HOC
1	Preference for authentic learning	3.12	3.21	3.27	F=31.61 $p < 0.001$	AB, AC
2	Preference for self-discovery learning	2.71	2.73	2.77	F=3.11 $p < 0.05$	AC
3	Preference for traditional learning	2.51	2.38	2.29	F=53.99 $p < 0.001$	AB, AC, BC
4	Importance of self regulation	2.69	2.66	2.66	NS	NS

3.3. Predicting student teacher preferences for learning environments

In order to predict how students think about learning environments we conducted a multiple regression analysis. The general purpose of multiple regression is to learn more about the relationship between several independent or predictor variables (i.e. the learning styles and background information on students) and a dependent or criterion variable (i.e. opinions on learning environments). Given the nature of the 16 learning style scales, it is not surprising that we have to deal with substantive multicollinearity in the regression analysis. Collinearity (or multicollinearity) is the undesirable situation where the correlations among the independent variables are strong. That means that some predictors provide redundant information in the regression model. There are no quick and easy solutions for this problem and in the end, one has usually to choose between removing variables from the model, or, combining them into cumulative indices. We used both ways in our analysis. First we investigated whether the use of the four learning styles (being a cumulative indices of the 16 learning style scales) is a good predictor of beliefs about learning environments. This turned out not to be the case (see also the very small difference we found between the learning styles concerning opinions on education). It seems that we loose too many predicting information by constructing the four learning styles. Therefore we followed the second approach in the following analysis, namely selecting the most informative and not intercorrelated predictors for the model. This selection is based on an investigation of the correlation matrix of the 16 learning scales and theoretical considerations. Finally the following predictors were included in the regression model: gender, type of teacher training, and 12 learning style scales (indicated in table 8).

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Table 8

Results of four multiple regression analyses predicting student teachers' preference for authentic learning, preference for self-discovery learning, preference for traditional learning and perceived importance of self regulation . All included regression coefficients are significant at the $p<0.01$ level.

	Preference for authentic learning		Preference for self-discovery learning		Preference for traditional learning		Importance of self regulation	
Predictors	B	β	B	β	B	β	B	β
(constant) (Males, primary)	(1.809)		(1.925)		(1.959)		(2.000)	
Sex (dummy coded)								
Females	0.05	0.93			-0.07	-0.09		
Type of teacher education (dummy coded)								
Pre-Primary	-0.11	-0.15					0.19	0.19
Lower secondary			-0.11	-0.14				
Upper secondary	-0.07	0.07	-0.31	-0.24	0.09	0.08	-0.17	-0.12
Processing strategies								
Deep processing	0.04	0.11						
Concrete processing								
Regulation strategies								
External regulation								
No regulation								
Orientation towards education								
Occupation oriented	0.05	0.11						
Test oriented					0.04	0.10		
Personally interested			0.06	0.11			0.05	0.08
Perceptions on education								
Recording knowledge					0.22	0.42	0.06	0.10
Constructing knowledge	0.12	0.21	0.11	0.14				
Usage of knowledge	0.11	0.21	0.05	0.07	-0.06	-0.11	0.07	0.09
Stimulating education								
Working together	0.04	0.13	0.04	0.08	-0.04	-0.11		
R^2	0.25		0.10		0.18		0.10	

B=not-standardized regression coefficient β = standardized regression coefficient

Before describing and interpreting the analyses of the four *preferences of learning environment* scales we notice that there are four predictors that do not have an impact in any of the regression functions. These are concrete processing, the two regulation strategies (external and no regulation) and stimulating education. The other predictors have a statistically significant impact on at least one of the 'preference for learning environment' scales.

Predicting students' preferences for authentic learning. The dummy coded predictors indicate that females have to a small degree a higher preference for authentic learning than males and that students preparing for pre-primary and upper secondary education have a lower preference, controlling for the effect of the other predictors. The other predictors learn that increasing students' preference for authentic learning implies that one should try to influence and direct students learning style towards constructing and using knowledge, working together, deep processing and occupation orientedness.The higher students score on these scales the higher their preference for authentic learning. Based on the predictors in the model 25% of the variance of student teachers' preference for authentic learning may be explained.

Predicting students' preferences for self-discovery learning. The dummy coded predictors indicate that there are no gender differences. Students preparing for secondary education (lower and upper) score lower than the pre-primary and primary groups when it comes to preferences for self-discovery learning. The other predictors learn that increasing students' preference for self-discovery learning implies that one should try to influence and direct students learning style towards a personal interest orientation and constructing and using

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knowledge in the learning process and, perceiving education as a means to stimulate learning in collaboration with others. The higher students score on these scales the higher their preference for self-discovery learning. The regression model for self-discovery learning does not explain as much variance as the previous one. The model explains merely 10% of the variance of student teachers' preference for self-discovery learning.

Predicting students' preferences for traditional learning. The dummy coded predictors learn that females have a somewhat lower preference for traditional learning than males and that students preparing for upper secondary education have a higher preference for traditional learning than the other groups, after controlling for the effect of the other predictors. The impact is however very small. The other predictors learn that decreasing students' preference for traditional learning implies that one should try to influence and direct students learning style towards using knowledge and working together, and away from test orientedness and above all recording knowledge. Of all regression analysis conducted and regression coefficients found, the impact of recording knowledge on the preference for traditional education is most pronounced. Based on the predictors in the model 18% of the variance of student teachers' preference for traditional learning may be explained.

Predicting students' preferences for self-regulation. The dummy coded predictors indicate that there are no gender differences. Students preparing for upper secondary education score (0.17) lower than the primary and lower secondary groups and students preparing for pre-primary score (0.19) higher than the primary and lower secondary groups. The other predictors learn that increasing students' opinion on the importance of self-regulated learning implies that one should try to influence and direct students learning style towards a personal interest orientation with more attention to using but also recording knowledge. The last prediction is rather unexpected here. In total 10% of the variance in student teachers' opinions on the importance of self-regulated learning is explained by the above regression model.

4. Conclusions, discussion and implications

4.1. General

Both the 'learning style' scales (Vermunt, 1992) and the 'preference for learning environment' scales (Roelofs, 2000b) are useful for exploration of aspects of vision and strategy within educational praxis. They enabled us to explore in detail differences between learning and preferences of learning environments and possible interactions. This research was not directed to simplify the complex interactions that occur between learning, learning environments and innovation since it took only one specific actor and several factors into account, namely the students (e.g. one actor, two domains, figure 1). The main goal was directed to exploration of student beliefs and preferences of student teachers in context. Although we could not report about the qualitative and following quantitative research phases, we do want to stress the importance of the use of more than one approach to reflect upon those differences. The use of mixed methodology in this kind of research is a felt necessity. Further research about this topic is certainly useful. We pointed out some questions about the changeability of perceptions we hope to explore in future or the taking into account of more variables that do seem to have an influence on e.g. the interaction between learning and preference of learning environment. Related to the specific case-studies we may indicate the importance of exploration of beliefs and preferences about learning and learning environments of teachers. Also taking into account other components of the e.g. social,

cultural and material situation is important. From a larger point of view it seems to be interesting to compare the described results with large scale and longitudinal research that is to be carried out in other institutions. This may lead to more prudence and/or generalization of found results. Bearing in mind that educational innovation is a complex issue which we do not want to simplify, the research enabled us to discuss come conclusions and implications that seem to be important from this specific perspective.

4.2. Beliefs about learning and assigned differences

Differences on 16 learning style related scales delivered most of the essential information. In general student teachers indicate to be strongly occupation oriented and that they favour the use of knowledge during the learning process itself. On the other hand there are also some indications for a traditional aspect in student teachers' beliefs about learning: they rather agree with the statement that learning is about recording knowledge and they rather rely than not rely on learning strategies such as stepwise, concrete processing and external regulations. Furthermore, student teachers rely little on self regulation strategies.

Beliefs about learning differ over the types of teacher training. Most apparent differences are the following: (1) the deep processing strategy and personal interested orientation towards learning significantly increase going from the pre-primary to the upper secondary group and (2) the external and no regulation strategy, the certificate and occupation orientation towards learning, and perception of learning as recording and using knowledge decrease going from the pre-primary to the upper secondary group. The primary education and lower secondary education groups always hold a position between these extremes.

Prototypes of learning styles seem no direct match for all cases. Specific problems occurred with the application oriented learning style. Another learning style in this case 'ad hoc learning style' was found. This leads to a moderate thinking about the so-called basic four learning styles. Reality seems to outline certain established boundaries. A question remains whether these four learning styles are typical for this type of respondent group or tend to be case generic? Although theoretically distinguishable, it seems that in practice most individuals do not uniquely match one particular prototypical learning style as pointed out by Vermunt (1992).

The research pointed out that students do differ in beliefs about learning. From the viewpoint of educational innovation towards more self regulated and cooperative learning, an important stress lays upon reflection about how present situations of learning environments take into account differences in learning within the departments of teacher education. This conclusion is not one way thinking. Also student teachers have to become aware about possible frictions between learning styles and the possibilities of learning that are shaped by learning environments. For some learners this will imply a needful shift of approach of learning and perception upon education. Throughout their teacher training program learners should be able to reflect upon their learning abilities and progress towards more independent and self regulated learning. It seems to be a long way considering the actual perceptions students tend to have about this kind of learning.

4.3. Preferences of learning environment and assigned differences

The mean scale scores indicate that in general all student teachers primarily take a position of authentic learning on the continuum from traditional to self-discovery learning. There are

however some (statistically significant but rather small) differences between the types of teacher training when it comes to preferences of learning environments. Most apparent is the finding that the preferences for self-discovery learning and importance of self-regulated learning decrease going from the pre-primary to the upper secondary group. Furthermore, student teachers preparing for primary education score significantly higher on preference for authentic learning than the other groups. This is however only true for females and not for males.

An additional remarkable result was found in the study of variance of perception between first second and third year students. Although statistically significant the differences found were in fact very small. This raises questions towards the possibilities and/or capabilities of teacher training institutions in order to influence and direct the preferences of learning environments of future teachers.

Our research has also pointed out that a 'one for all innovation policy' can not last within the different types of education. Innovation policy makers have to take in to account the different levels of innovativeness students seem to have. The differences of preferences of learning environments that students teacher have lays an emphasis on the importance of a teacher training program in which variance of learning environments is a central topic.

4.4. Linking learning styles and preferences of learning environments

The purpose of the four conducted multiple regressions was to learn more about the relationship between the learning styles and background information on students on the one hand and students' perceptions of learning environments on the other hand. In general terms we concluded that institutions for teacher training which aim to stimulate future teachers towards more authentic and finally self-discovery learning and away from traditional learning should influence the perception of education of their students towards using and constructing knowledge, working together and away from recording knowledge. A beneficial impact is also expected from maximising deep processing strategies, students' personal interest and occupation orientedness in learning and from minimizing test orientedness. Although some directions can be pointed out, many questions remain about the 80% (and more) of non explained variance in the preferences for learning environments that was found. It can not be said that on the basis of certain learning styles one can derive a directed link towards the type of learning environment a learner prefers. This may lead to assumptions that learners are not very aware of their own learning style and certainly not able to critically reflect whether their learning style is in friction with the type of learning environment they prefer.

Student teachers need to know how different learning environments have an influence on learning styles. It seems that to develop student teacher perceptions an important aspect is to experience differences in learning environment within the teacher training institute and during practice education. They should be enabled to explore and expand their present perceptions about subjective felt 'good' and 'bad' learning environments. It underlines the importance of ongoing reflection upon the influence of 'subjective theories' within educational practice (Vandenberghe & Kelchtermans, 2002). This could be reached by stimulus of e.g. adequate action research. It is known that this can form a base for ongoing and future professionalism. It seems to be a stimulus for more adequate and realistic innovation strategies that also take into account the present situation and motivation of the teacher. This process of reflection and action itself may be seen as an ongoing assessment process for optimising educational

practice on every level (student, teacher, institution). Innovation policy makers should be aware by this kind of research that gradual innovation strategies are required to take into account that educational change is a process and time-based learning process. Research directed to explore the boundaries of educational innovation enables to blur the boundaries between past and future education. It keeps a necessary focus on the possibilities of innovation in the ongoing present situation.

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